

Infrared Transceiver Module (SIR, 115.2 kbit/s) for IrDA[®] applications

Description

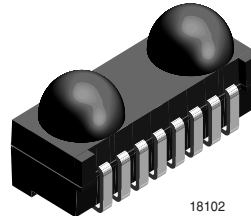
The TFDU4300 transceiver is an infrared transceiver module compliant to the latest IrDA physical layer standard for fast infrared data communication, supporting IrDA speeds up to 115.2 kbit/s (SIR) and carrier based remote control. The transceiver module consists of a pin photodiode, an infrared emitter (IRED), and a low-power control IC to provide a total front-end solution in a single package. This device covers an extended IrDA low power range of close to 1 m when the internal intensity control is used. With one external current control resistor the current can be adjusted for shorter ranges.

This Vishay SIR transceiver is built in a new smaller package using the experiences of the lead frame BabyFace technology.

The Rxd output pulse width is independent of the optical input pulse width and stays always at a fixed pulse width thus making the device optimum standard Endecs and interfaces. TFDU4300 has a tri-state output and is floating in shut-down mode with a weak pull-up.

Features

- Compliant to the latest IrDA physical layer specification (9.6 kbit/s to 115.2 kbit/s) and TV Remote Control, bi-directional operation included.
- Operates from 2.4 V to 5.5 V within specification over full temperature range from - 30 °C to + 85 °C
- Logic voltage 1.5 V to 5.5 V is independent of IRED driver and analog supply voltage
- Split power supply, transmitter and receiver can be operated from two power supplies with relaxed requirements saving costs, US Patent No. 6,157,476
- Extended IrDA Low Power Range to about 70 cm
- Typical Remote Control Range 12 m
- Low Power Consumption (< 0.12 mA Supply Current)
- Power Shutdown Mode (< 5 μ A Shutdown Current in Full Temperature Range, up to 85 °C)
- Surface Mount Package, low profile (2.5 mm) - (L 8.5 mm \times W 2.5 mm \times H 2.9 mm)
- High Efficiency Emitter



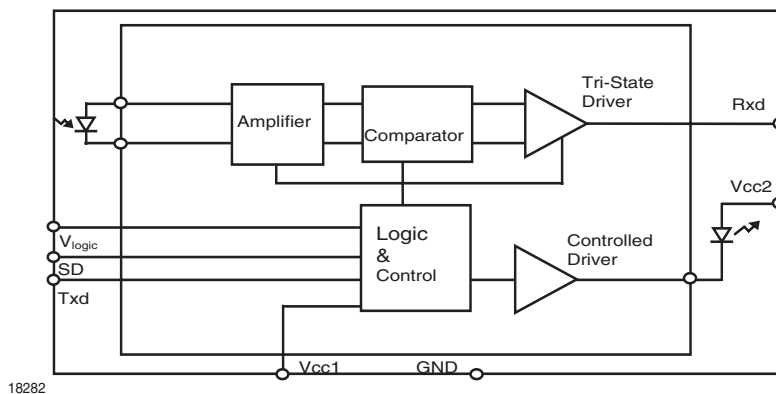
- Low Profile (Universal) Package Capable of Surface Mount Soldering to Side and Top View Orientation
- Directly Interfaces with Various Super I/O and Controller Devices as e.g. TOIM4232
- Tri-state-Receiver Output, floating in shut down with a weak pull-up
- Compliant with IrDA Background Light Specification
- EMI Immunity in GSM Bands > 300 V/m verified

Applications

- Ideal for Battery Operated Applications
- Telecommunication Products (Cellular Phones, Pagers)
- Digital Still and Video Cameras
- Printers, Fax Machines, Photocopiers, Screen
- Projectors
- Medical and Industrial Data Collection
- Diagnostic Systems
- Notebook Computers, Desktop PCs, Palmtop Computers (Win CE, Palm PC), PDAs
- Internet TV Boxes, Video Conferencing Systems
- External Infrared Adapters (Dongles)
- Data Loggers
- GPS
- Kiosks, POS, Point and Pay Devices including IrFM - Applications

Parts Table

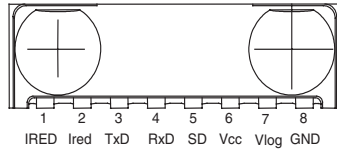
| Part | Description | Qty / Reel |
|--------------|---|------------|
| TFDU4300-TR1 | Oriented in carrier tape for side view surface mounting | 750 pcs |
| TFDU4300-TR3 | Oriented in carrier tape for side view surface mounting | 2500 pcs |
| TFDU4300-TT1 | Oriented in carrier tape for top view surface mounting | 750 pcs |
| TFDU4300-TT3 | Oriented in carrier tape for top view surface mounting | 2500 pcs |



Pin Description

| Pin Number | Function | Description | I/O | Active |
|------------|--------------------------------|---|-----|--------|
| 1 | V _{CC2} IRED Anode | Connect IRED anode directly to the power supply (V _{CC2}). IRED current can be decreased by adding a resistor in series between the power supply and IRED anode. A separate unregulated power supply can be used at this pin. | | |
| 2 | IRED Cathode | IRED Cathode, internally connected to the driver transistor | | |
| 3 | Txd | This Schmitt-Trigger input is used to transmit serial data when SD is low. An on-chip protection circuit disables the LED driver if the Txd pin is asserted for longer than 300 μs. The input threshold voltage adapts to and follows the logic voltage swing defined by the applied V _{logic} voltage. | I | HIGH |
| 4 | Rxd | Received Data Output, push-pull CMOS driver output capable of driving standard CMOS or TTL loads. During transmission the Rxd output is inactive. No external pull-up or pull-down resistor is required. Floating with a weak pull-up of 500 kΩ (typ.) in shutdown mode. The voltage swing is defined by the applied V _{logic} voltage | O | LOW |
| 5 | SD | Shutdown. The input threshold voltage adapts to and follows the logic voltage swing defined by the applied V _{logic} voltage. | I | HIGH |
| 6 | V _{CC1} | Supply Voltage | | |
| 7 | V _{logic} | V _{logic} defines output range. The Rxd output range is from 0 V to V _{logic} , for optimum noise suppression the inputs- logic decision level is 0.5 x V _{logic} | I | |
| 8 | GND | Ground | | |

Pinout



Definitions:

In the Vishay transceiver data sheets the following nomenclature is used for defining the IrDA operating modes:

SIR: 2.4 kbit/s to 115.2 kbit/s, equivalent to the basic serial infrared standard with the physical layer version IrPhy 1.0

MIR: 576 kbit/s to 1152 kbit/s

FIR: 4 Mbit/s

VFIR: 16 Mbit/s

MIR and FIR were implemented with IrPhy 1.1, followed by IrPhy 1.2, adding the SIR Low Power Standard. IrPhy 1.3 extended the Low Power Option to MIR and FIR and VFIR was added with IrPhy 1.4. A new version of the standard in any case obsoletes the former version.

With introducing the updated versions the old versions are obsolete. Therefore the only valid IrDA standard is the actual version IrPhy 1.4 (in Oct. 2002).

Absolute Maximum Ratings

Reference point Ground (pin 8) unless otherwise noted.

Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.

| Parameter | Test Conditions | Symbol | Min | Typ. | Max | Unit |
|--|--|-----------------------|-------|------|--------------------------|------|
| Supply voltage range, transceiver | - 0.3 V < V _{CC2} < 6 V - 0.5 V < V _{logic} < 6 V | V _{CC1} | - 0.5 | | + 6.0 | V |
| Supply voltage range, transmitter | - 0.5 V < V _{CC1} < 6 V - 0.5 V < V _{logic} < 6 V | V _{CC2} | - 0.5 | | + 6.0 | V |
| Supply voltage range, V _{logic} | - 0.5 V < V _{CC1} < 6 V - 0.3 V < V _{CC2} < 6 V | V _{logic} | - 0.5 | | + 6.0 | V |
| Voltage @ Rxd | - 0.5 V < V _{CC1} < 6 V - 0.3 V < V _{logic} < 6 V | V _{Rxd} | - 0.5 | | V _{logic} + 6.0 | V |
| Voltage at all inputs and outputs | V _{in} < V _{CC1} is allowed | V _{IN} | - 0.5 | | + 6.0 | V |
| Input current | for all pins, except IRED anode pin | | | | 10 | mA |
| Output sinking current | | | | | 25 | mA |
| Power dissipation | see derating curve | P _D | | | 250 | mW |
| Junction temperature | | T _J | | | 125 | °C |
| Ambient temperature range (operating) | | T _{amb} | - 30 | | + 85 | °C |
| Storage temperature range | | T _{stg} | - 40 | | + 100 | °C |
| Soldering temperature | see recommended solder profile | | | | 240 | °C |
| Average output current, pin 1 | | I _{IRED(DC)} | | | 125 | mA |
| Repetitive pulsed output current, pin 1 to pin 2 | t < 90 μs, t _{on} < 20 % | I _{IRED(RP)} | | | 600 | mA |

Eye safety information

| Parameter | Test Conditions | Symbol | Min | Typ. | Max | Unit |
|-------------------------------|--|--------|-----|------|--------------------------------------|-------|
| Virtual source size | Method: (1-1/e) encircled energy | d | 1.3 | 1.8 | | mm |
| Maximum intensity for class 1 | IEC60825-1 or EN60825-1, edition Jan. 2001, operating below the absolute maximum ratings | I_e | | | ^{*)} (500 ^{**)} | mW/sr |

^{*)} Due to the internal limitation measures the device is a "class 1" device under all conditions.

^{**)} IrDA specifies the max. intensity with 500 mW/sr.

Electrical Characteristics

Transceiver

Tested @ $T_{amb} = 25\text{ }^\circ\text{C}$, $V_{CC1} = V_{CC2} = 2.7\text{ V to } 5.5\text{ V}$ unless otherwise noted.

Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.

| Parameter | Test Conditions | Symbol | Min | Typ. | Max | Unit |
|--|---|------------|------------------------|------|-------------------------|------------------|
| Supply voltage | Remark: For $2.4\text{ V} < V_{CC1} < 2.6\text{ V}$ @ $T_{amb} < -25\text{ }^\circ\text{C}$ a minor reduction of the receiver sensitivity may occur | V_{CC1} | 2.4 | | 5.5 | V |
| Dynamic supply current | SD = Low, $E_e = 1\text{ klx}^*)$, V_{CC} | I_{CC1} | | 90 | 130 | μA |
| | SD = Low, $E_e = 1\text{ klx}^*)$, V_{log} , pin 7, no signal, no load @ Rxd | I_{log} | | | 1 | μA |
| Average dynamic supply current, transmitting | $I_{RED} = 300\text{ mA}$, 25 % Duty Cycle | I_{CC} | | | 65 | mA |
| Standby supply current | SD = High, $T = 25\text{ }^\circ\text{C}$, $E_e = 0\text{ klx}$ | I_{SD} | | | 0.1 | μA |
| | SD = High, $T = 70\text{ }^\circ\text{C}$ | I_{SD} | | | 2 | μA |
| | SD = High, $T = 85\text{ }^\circ\text{C}$ | I_{SD} | | | 3 | μA |
| Standby supply current, V_{logic} | no signal, no load | I_{log} | | | 1 | μA |
| Operating temperature range | | T_A | - 30 | | + 85 | $^\circ\text{C}$ |
| Output voltage low, Rxd | $C_{Load} = 15\text{ pF}$ | V_{OL} | - 0.5 | | $0.15 \times V_{logic}$ | V |
| Output voltage high, Rxd | $I_{OH} = -500\text{ }\mu\text{A}$ | V_{OH} | $0.8 \times V_{logic}$ | | $V_{logic} + 0.5$ | V |
| | $I_{OH} = -250\text{ }\mu\text{A}$, $C_{Load} = 15\text{ pF}$ | V_{OH} | $0.9 \times V_{logic}$ | | $V_{logic} + 0.5$ | V |
| Rxd to V_{CC1} impedance | | R_{Rxd} | 400 | 500 | 600 | k Ω |
| Input voltage low (Txd, SD) | | V_{IL} | - 0.5 | | 0.5 | V |
| Input voltage high (Txd, SD) | CMOS level ^{**)} | V_{IH} | $V_{logic} - 0.5$ | | 6 | V |
| Input leakage current (Txd, SD) | $V_{IN} = 0.9 \times V_{logic}$ | I_{ICH} | - 2 | | + 2 | μA |
| Controlled pull down current | SD, Txd = "0" to "1", $0 < V_{IN} < 0.15 V_{logic}$ | I_{IRTx} | | | + 150 | μA |
| | SD, Txd = "0" to "1", $0 < V_{IN} > 0.7 V_{logic}$ | I_{IRTx} | - 1 | 0 | 1 | μA |
| Input capacitance (Txd, SD) | | C_I | | | 5 | pF |

^{*)} Standard illuminant A

^{**)} To provide an improved immunity with increasing V_{logic} the typical threshold level is increasing with V_{logic} and set to $0.5 \times V_{logic}$. It is recommended to use the specified min/max values to avoid increased operating current.

**Optoelectronic Characteristics****Receiver**

Tested @ $T_{amb} = 25\text{ }^{\circ}\text{C}$, $V_{CC1} = V_{CC2} = 2.7\text{ V}$ to 5.5 V unless otherwise noted.

Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.

| Parameter | Test Conditions | Symbol | Min | Typ. | Max | Unit |
|--|--|--------------|------------|------------|---------------------|---|
| Minimum detection threshold irradiance, SIR Mode | 9.6 kbit/s to 115.2 kbit/s $\lambda = 850\text{ nm} - 900\text{ nm}$ $\alpha = 0^{\circ}, 15^{\circ}$ | E_e | | 40 (4) | 80 (8) | mW/m^2 ($\mu\text{W}/\text{cm}^2$) |
| Maximum detection threshold irradiance | $\lambda = 850\text{ nm} - 900\text{ nm}$ | E_e | | 5 (500) | | kW/m^2 (mW/cm^2) |
| Receiver input irradiance for low signal suppression ^{*)} | $\lambda = 850\text{ nm} - 900\text{ nm}$ $t_r, t_f < 40\text{ ns}$, $t_{po} = 1.6\text{ }\mu\text{s}$ @ $f = 115\text{ kHz}$, no output signal allowed | E_e | 4 (0.4) | | | mW/m^2 ($\mu\text{W}/\text{cm}^2$) |
| Rise time of output signal | 10 % to 90 %, $C_L = 15\text{ pF}$ | $t_{r(Rxd)}$ | 20 | | 100 | ns |
| Fall time of output signal | 90 % to 10 %, $C_L = 15\text{ pF}$ | $t_{f(Rxd)}$ | 20 | | 100 | ns |
| Rxd pulse width of output signal | input pulse length $> 1.2\text{ }\mu\text{s}$ | t_{PW} | 1.7 | 2.0 | 3.0 | μs |
| Stochastic jitter, leading edge | input irradiance = $100\text{ mW}/\text{m}^2$, $\leq 115.2\text{ kbit/s}$ | | | | 250 | ns |
| Standby /Shutdown delay, receiver startup time | after shutdown active or power-on | | | | 1.0 | ms |
| Latency | | t_L | | 100 | 300 ^{**)} | μs |

^{*)} Equivalent to IrDA Background Light and Electromagnetic Field Test: Fluorescent Lighting Immunity

^{**)} Compliment to IrDA@ SIR

Transmitter

Tested @ $T_{amb} = 25\text{ }^{\circ}\text{C}$, $V_{CC1} = V_{CC2} = 2.7\text{ V}$ to 5.5 V unless otherwise noted.

Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.

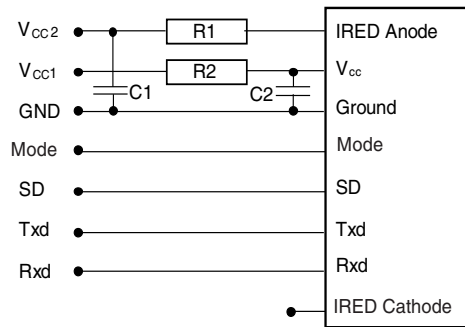
| Parameter | Test Conditions | Symbol | Min | Typ. | Max | Unit |
|---|--|-------------------------|-----------|----------|------------------|---------------|
| IRED operating current limitation | No external resistor for current limitation ^{*)} | I_D | 250 | 300 | 350 | mA |
| Forward voltage of built-in IRED | $I_f = 300\text{ mA}$ | V_f | 1.4 | 1.8 | 1.9 | V |
| Output leakage IRED current | $T_{xd} = 0\text{ V}$, $0 < V_{CC1} < 5.5\text{ V}$ | I_{IRED} | - 1 | | 1 | μA |
| Output radiant intensity | $\alpha = 0\text{ }^{\circ}$, 15 ° $T_{xd} = \text{High}$, $SD = \text{Low}$ | I_e | 30 | 65 | | mW/sr |
| | $V_{CC1} = 5.0\text{ V}$, $\alpha = 0\text{ }^{\circ}$, 15 ° $T_{xd} = \text{Low}$ or $SD = \text{High}$ (Receiver is inactive as long as $SD = \text{High}$) | I_e | | | 0.04 | mW/sr |
| Output radiant intensity, angle of half intensity | | α | | ± 24 | | $^{\circ}$ |
| Peak - emission wavelength ^{**)} | | λ_p | 880 | | 900 | nm |
| Spectral bandwidth | | $\Delta\lambda$ | | 45 | | nm |
| Optical rise time, fall time | | t_{ropt} , t_{fopt} | 10 | | 100 | ns |
| Optical output pulse duration | input pulse width $1.63\text{ }\mu\text{s}$, 115.2 kbit/s | t_{opt} | 1.6 | 1.63 | 1.8 | μs |
| | input pulse width $t_{Txd} < 20\text{ }\mu\text{s}$ | t_{opt} | t_{Txd} | | $t_{Txd} + 0.15$ | μs |
| | input pulse width $t_{Txd} \geq 20\text{ }\mu\text{s}$ | t_{opt} | 20 | | 300 | μs |
| Optical overshoot | | | | | 25 | % |

^{*)} Using an external current limiting resistor is allowed and recommended to reduce IRED intensity and operating current when current reduction is intended to operate at the IrDA low power conditions. E.g. for $V_{CC2} = 3.3\text{ V}$ a current limiting resistor of $R_S = 56\text{ }\Omega$ will allow a power minimized operation at IrDA low power conditions.

^{**)} Note: Due to this wavelength restriction compared to the IrDA spec of 850 nm to 900 nm the transmitter is able to operate as source for the standard Remote Control applications with codes as e.g. Phillips RC5/RC6[®] or RECS 80.

Recommended Circuit Diagram

Operated with a clean low impedance power supply the TFDU4300 needs no additional external components. However, depending on the entire system design and board layout, additional components may be required (see figure 1).



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Figure 1. Recommended Application Circuit

Recommended Application Circuit

The capacitor C1 is buffering the supply voltage and eliminates the inductance of the power supply line. This one should be a Tantalum or other fast capacitor to guarantee the fast rise time of the IRED current. The resistor R1 is the current limiting resistor, which may be used to reduce the operating current to levels below the specified controlled values for saving battery power.

Vishay's transceivers integrate a sensitive receiver and a built-in power driver. The combination of both needs a careful circuit board layout. The use of thin, long, resistive and inductive wiring should be avoided. The inputs (Txd, SD) and the output Rxd should be directly (DC) coupled to the I/O circuit.

The capacitor C2 combined with the resistor R2 is the low pass filter for smoothing the supply voltage. R2, C1 and C2 are optional and dependent on the quality of the supply voltages V_{CCx} and injected noise. An unstable power supply with dropping voltage during transmission may reduce the sensitivity (and transmission range) of the transceiver.

The placement of these parts is critical. It is strongly recommended to position C2 as close as possible to the transceiver power supply pins. An Tantalum capacitor should be used for C1 while a ceramic capacitor is used for C2.

In addition, when connecting the described circuit to the power supply, low impedance wiring should be used.

When extended wiring is used the inductance of the power supply can cause dynamically a voltage drop at V_{CC2}. Often some power supplies are not apply to follow the fast current rise time. In that case another 4.7 μF (type, see table under C1) at V_{CC2} will be helpful.

Under extreme EMI conditions as placing an RF-transmitter antenna on top of the transceiver, we recommend to protect all inputs by a low-pass filter, as a minimum a 12 pF capacitor, especially at the Rxd port. The transceiver itself withstands EMI at GSM frequencies above 300 V/m. When interference is observed, it is picked up by the wiring to the inputs. It is verified by DPI (direct power injection) measurements that as long as the interfering RF - voltage is below the logic threshold levels of the inputs and equivalent levels at the outputs no interference is expected.

One should keep in mind that basic RF - design rules for circuit design should be taken into account. Especially longer signal lines should not be used without termination. See e.g. "The Art of Electronics" Paul Horowitz, Winfield Hill, 1989, Cambridge University Press, ISBN: 0521370957.

Table 1.
Recommended Application Circuit Components

| Component | Recommended Value | Vishay Part Number |
|-----------|-----------------------------------|----------------------|
| C1 | 4.7 μF, 16 V | 293D 475X9 016B |
| C2 | 0.1 μF, Ceramic | VJ 1206 Y 104 J XXMT |
| R1 | depends on current to be adjusted | |
| R2 | 47 Ω, 0.125 W | CRCW-1206-47R0-F-RT1 |

I/O and Software

In the description, already different I/Os are mentioned. Different combinations are tested and the function verified with the special drivers available from the I/O suppliers. In special cases refer to the I/

O manual, the Vishay application notes, or contact directly Vishay Sales, Marketing or Application. For operating at RS232 ports as ENDEC TOIM4232 is recommended.

Truth table

| Inputs | | | Outputs | | Remark |
|----------------|-----------------|--|---|----------------|--|
| SD | Txd | Optical input Irradiance mW/m ² | Rxd | Transmitter | Operation |
| high > 1 ms | x | x | weakly pulled (500 kΩ) to V _{CC1} | 0 | Shutdown |
| low | high | x | high inactive | I _e | Transmitting |
| low | high > 50 μs | x | high inactive | 0 | Protection is active |
| low | low | < 4 | high inactive | 0 | Ignoring low signals below the IrDA defined threshold for noise immunity |
| low | low | > Min. Detection Threshold Irradiance < Max. Detection Threshold Irradiance | low (active) | 0 | Response to an IrDA compliant optical input signal |
| low | low | > < Max. Detection Threshold Irradiance | undefined | 0 | Overload conditions can cause unexpected outputs |

Recommended Solder Profile

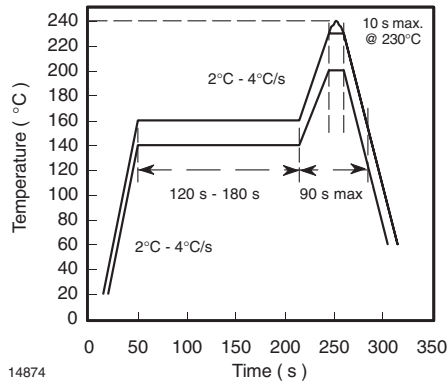
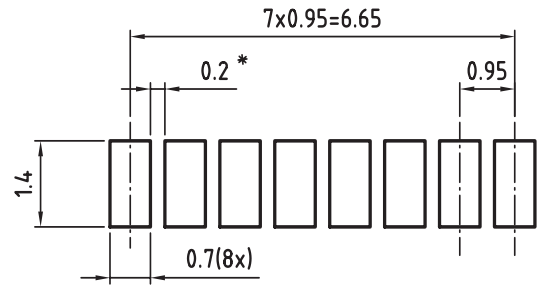


Figure 2. Recommended Solder Profile

Footprint



* min 0.2 Photoimageable solder mask recommended between pads to prevent bridging

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Figure 4. Footprint

Current Derating Diagram

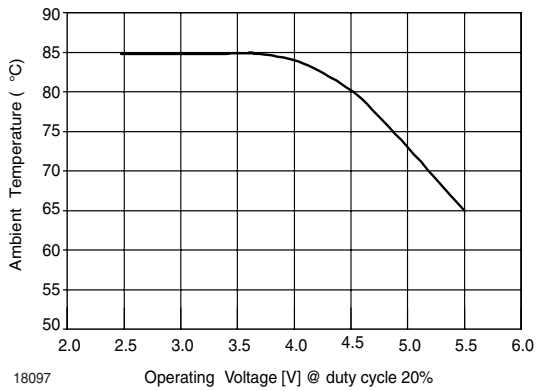
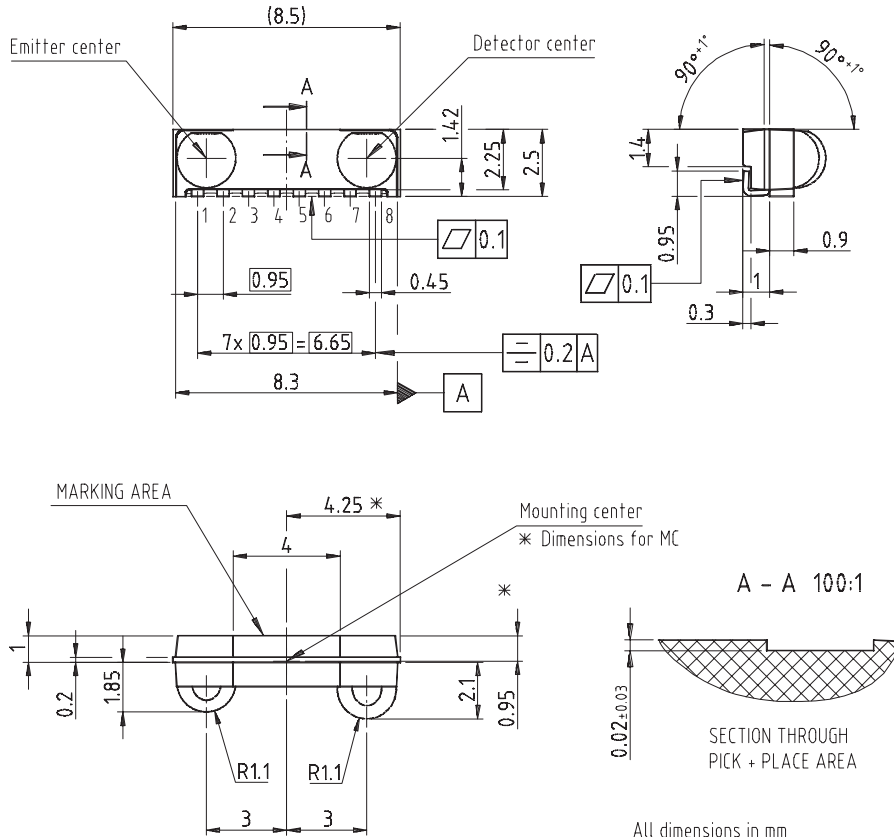
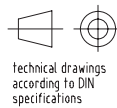


Figure 3. Temperature Derating Diagram

TFDU4300 (Universal) Package (Mechanical Dimensions)



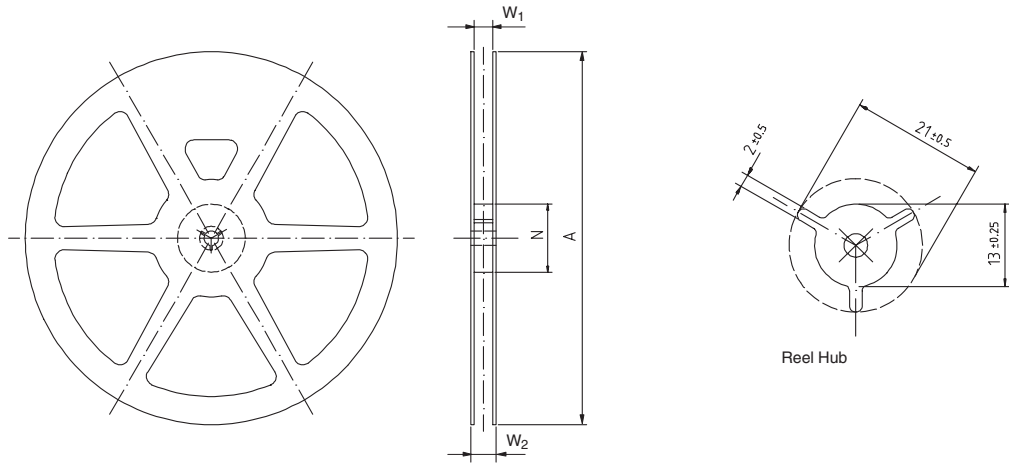
All dimensions in mm



Drawing-No.: 6.550-5252.01-4
Issue: 1; 17.01.03

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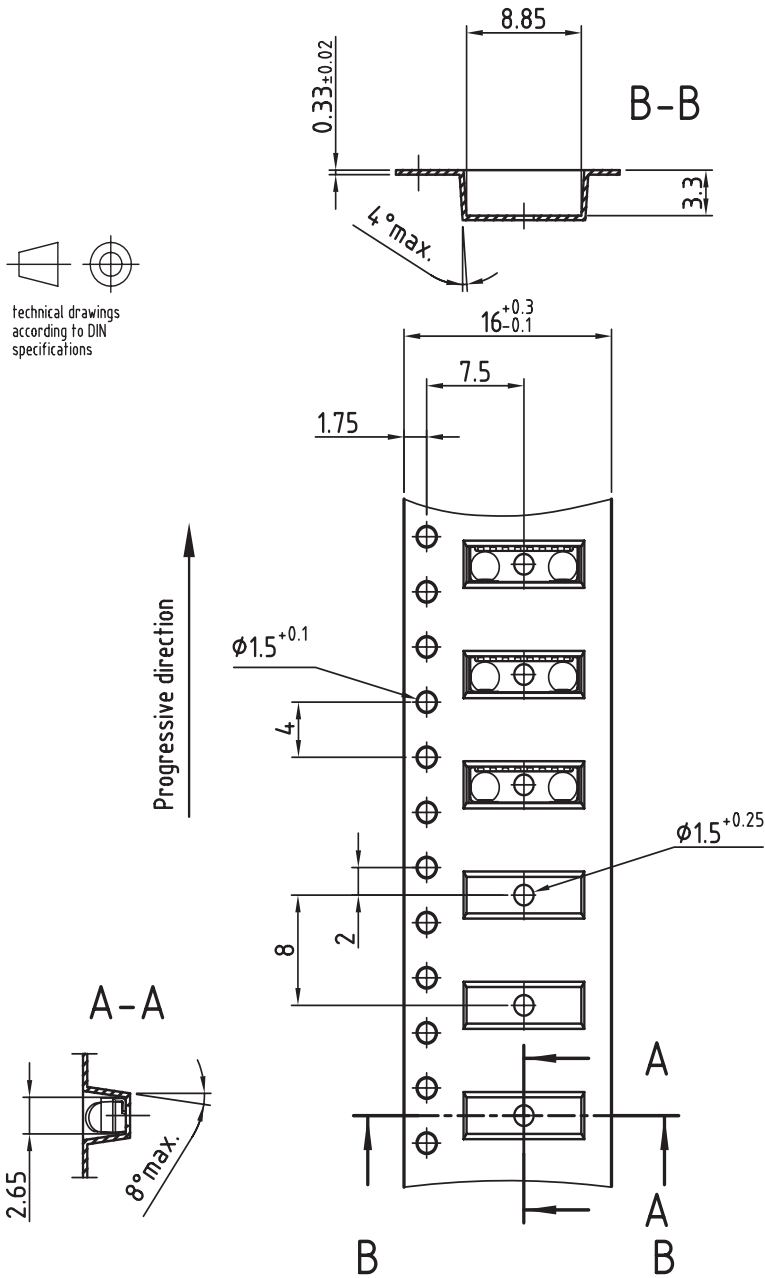
Reel Dimensions



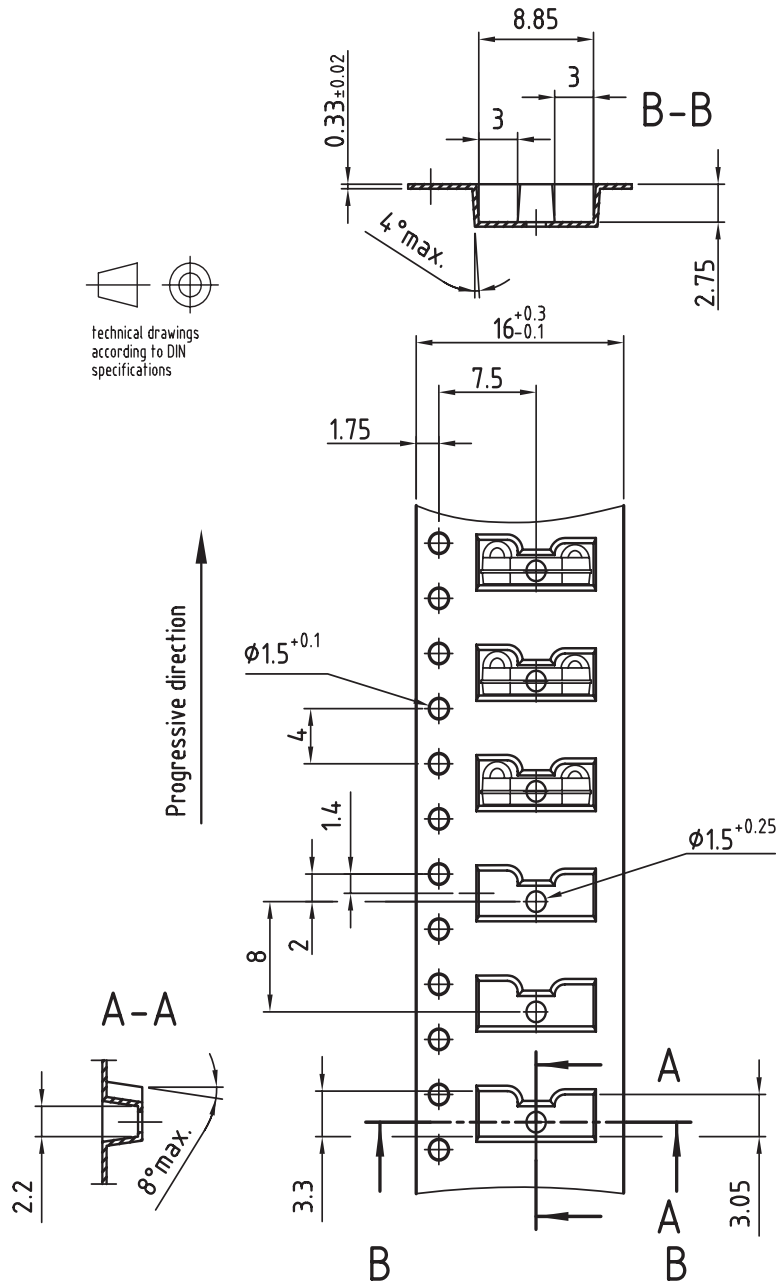
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| Tape Width | A max. | N | W_1 min. | W_2 max. | W_3 min. | W_3 max. |
|------------|--------|----|------------|------------|------------|------------|
| mm | mm | mm | mm | mm | mm | mm |
| 16 | 180 | 60 | 16.4 | 22.4 | 15.9 | 19.4 |
| 16 | 330 | 50 | 16.4 | 22.4 | 15.9 | 19.4 |

Tape Dimensions



18306



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Ozone Depleting Substances Policy Statement

It is the policy of **Vishay Semiconductor GmbH** to

1. Meet all present and future national and international statutory requirements.
2. Regularly and continuously improve the performance of our products, processes, distribution and operating systems with respect to their impact on the health and safety of our employees and the public, as well as their impact on the environment.

It is particular concern to control or eliminate releases of those substances into the atmosphere which are known as ozone depleting substances (ODSs).

The Montreal Protocol (1987) and its London Amendments (1990) intend to severely restrict the use of ODSs and forbid their use within the next ten years. Various national and international initiatives are pressing for an earlier ban on these substances.

Vishay Semiconductor GmbH has been able to use its policy of continuous improvements to eliminate the use of ODSs listed in the following documents.

1. Annex A, B and list of transitional substances of the Montreal Protocol and the London Amendments respectively
2. Class I and II ozone depleting substances in the Clean Air Act Amendments of 1990 by the Environmental Protection Agency (EPA) in the USA
3. Council Decision 88/540/EEC and 91/690/EEC Annex A, B and C (transitional substances) respectively.

Vishay Semiconductor GmbH can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.

**We reserve the right to make changes to improve technical design
and may do so without further notice.**

Parameters can vary in different applications. All operating parameters must be validated for each customer application by the customer. Should the buyer use Vishay Semiconductors products for any unintended or unauthorized application, the buyer shall indemnify Vishay Semiconductors against all claims, costs, damages, and expenses, arising out of, directly or indirectly, any claim of personal damage, injury or death associated with such unintended or unauthorized use.

Vishay Semiconductor GmbH, P.O.B. 3535, D-74025 Heilbronn, Germany
Telephone: 49 (0)7131 67 2831, Fax number: 49 (0)7131 67 2423